R&S®TMU9evo AIR-COOLED UHF TRANSMITTER FAMILY

The best even better

Product Brochure
Version 05.00

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The R&S®TMU9evo UHF transmitter represents the next step toward minimizing operating costs in the medium power class. The transmitter's superior efficiency of up to 40 % for COFDM and 43 % for ATSC, combined with its long-life design, results in an exceptional operating experience. Network operators benefit greatly from low operating costs throughout the product's lifecycle.

Front view of the R&S®TMU9evo

The air-cooled R&S®TMU9evo UHF medium-power transmitter delivers output power from 400 W to 3.0 kW for COFDM as well as for ATSC TV standards (including ATSC 3.0). The R&S®TMU9evo is an ideal choice for network operators who demand both excellent quality of service and want to be perfectly prepared to handle channel clearance programs.

As a member of the successful R&S®Tx9 transmitter generation, the R&S®TMU9evo minimizes total cost of ownership (TCO) with its unrivaled long-lived transmitter design, minimal space requirements and efficiency of up to 40 % for COFDM. The new adaptive efficiency optimization feature ensures maximum energy cost savings even after channel changes or output power adjustments.

The transmitter is based on the established R&S®TMU9 platform with all of its proven strengths, including the MultiTX concept, outstanding system flexibility and ease of use. Thousands of installed R&S®TMU9 transmitters around the globe are proof of how well the platform meets network operators' needs.

Key facts

- Even greater efficiency gains through many years of experience with Doherty technology
- Maximum on-air time
- Built on the strengths of the established R&S®TMU9 platform
- Intelligent efficiency optimization for minimized energy costs for all types of applications
- Future-ready ATSC 3.0 support

BENEFITS AND KEY FEATURES

E5 – efficiency to the power of five

The R&S®Tx9 transmitter generation scores with efficiency at five different levels:

- **Efficiency in energy**
  Economical: minimum power consumption for cost savings over system lifetime
- **Efficiency in space**
  Space-saving: several transmitters and additional components in one rack
- **Efficiency in operation**
  Smooth installation, operation and maintenance
- **Efficiency in configuration**
  Customer-focused: modular solutions for flexible system configuration
- **Efficiency for a lifetime**
  Future-ready: can be expanded to accommodate new standards and technologies

Most mature UHF amplifier design
▶ page 4

Operational efficiency in every aspect
▶ page 6

Compact design and easy operation
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Future-ready ATSC 3.0 support
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Rohde&Schwarz – the partner you can count on
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MODEL OVERVIEW

R&S®TMU9evo UHF transmitter family

Number of amplifiers	Output power (AVG) for digital TV standards [1] with Doherty and normal operation [2]	Rack included	Dimensions (W × H × D)	Possible MultiTX configurations
1	400 W	optional	483 mm × 132 mm (3 RU) × 550 mm; 19 in × 5.2 in × 21.6 in	up to 6 transmitters per rack
2	750 W	optional	483 mm × 352 mm (8 RU) × 550 mm; 19 in × 13.9 in × 21.6 in	up to 4 transmitters per rack
3	1.15 kW	optional	483 mm × 440 mm (10 RU) × 550 mm; 19 in × 17.3 in × 21.6 in	up to 3 transmitters per rack
4	1.5 kW	optional	483 mm × 528 mm (12 RU) × 550 mm; 19 in × 20.8 in × 21.6 in	2 transmitters per rack
6	2.3 kW	1 rack	600 mm × 2350 mm (42 RU) × 800 mm; 23.62 in × 92.52 in × 31.49 in	no MultiTX configuration
8	3.0 kW	1 rack	600 mm × 2350 mm (42 RU) × 800 mm; 23.62 in × 92.52 in × 31.49 in	no MultiTX configuration
12	4.3 kW	2 racks	1200 mm × 2350 mm (42 RU) × 800 mm; 47.24 in × 92.52 in × 31.49 in	no MultiTX configuration
16	5.8 kW	2 racks	1200 mm × 2350 mm (42 RU) × 800 mm; 47.24 in × 92.52 in × 31.49 in	no MultiTX configuration

[1] Supported standards: DVB-T2, DVB-T, ISDB-T_B, DTMB, ATSC, ATSC 3.0.
[2] Before bandpass filter.

MOST MATURE UHF AMPLIFIER DESIGN

Superior efficiency thanks to R&S®PMU905 amplifier with enhanced Doherty technology

Focusing on the challenges faced by network operators has always been one of the driving principles behind transmitter development at Rohde&Schwarz. Customer satisfaction and the market success experienced with the R&S®TMU9 are proof of how well the R&S®TMU9 platform satisfies this principle. One of the primary challenges for network operators is and will remain the reduction of operating costs. The R&S®TMU9evo incorporates all of the proven and valued strengths of the R&S®TMU9 platform, while taking key features such as efficiency and compactness to the next level. Built on years of pioneering achievements with Doherty technology, the R&S®TMU9evo offers even greater efficiency.

The introduction of the Rohde&Schwarz Doherty technology in the R&S®Tx9 transmitter generation has revolutionized the broadcast transmitter market. With the R&S®TMU9evo, this amplifier technology is now available for the first time in the medium power class, allowing the R&S®TMU9evo to reach the next level of efficiency. The transmitter sets the benchmark with an efficiency of up to 40%. It reduces energy costs by up to 50% compared to the energy cost savings achieved on average by the installed base of transmitters in this power class.

Years of experience and continuous development have given Rohde&Schwarz complete mastery over the Doherty technology, which the company has been able to deploy to the greatest advantage.

The Rohde&Schwarz multiband Doherty technology was first introduced in the R&S®Tx9 transmitter generation in 2012. This amplifier technology has since become synonymous with energy cost savings for many network operators. Thousands of amplifier modules employing Rohde&Schwarz multiband Doherty technology are now in use around the world. Each and every day, Rohde&Schwarz technology saves in excess of 1 000 000 kWh compared to conventional amplifier technology. This corresponds to the daily power consumption of a medium-sized European town.

Wideband amplifier design

Thanks to the Rohde&Schwarz multiband Doherty technology, the R&S®PMU905 amplifier can be operated over the entire frequency range without hardware modifications. Efficiency optimization for the various frequency bands is even easier with the R&S®PMU905 than with the predecessor model. With the R&S®TMU9evo, network operators need not worry about channel changes.

The R&S®PMU905 amplifier (400 W) offers the highest efficiency and highest power density in its class.

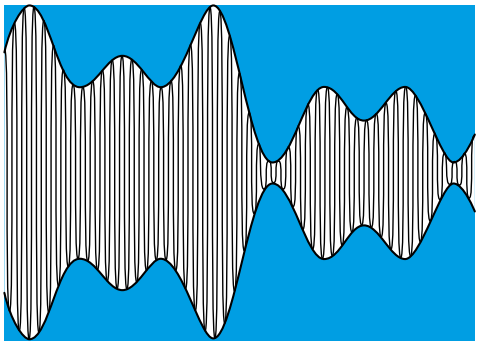
Optimum efficiency even after channel changes

Normally, transmitters are not operated at their full nominal power. Conventional transmitters experience a significant reduction in efficiency at reduced power. This is where another intelligent R&S®TMU9evo technology comes into play. The R&S®TMU9evo transmitter family features power agile efficiency, with the result that transmitter efficiency remains optimal even at reduced power. This is made possible through complete control of the Doherty amplifier circuits, intelligent control of amplifier parameters, and highly advanced precorrection.

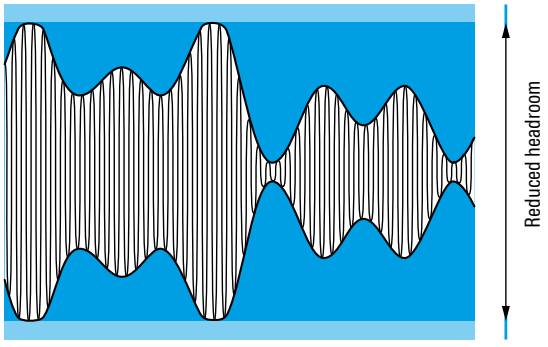
To allow network operators to exploit this technology to maximize energy economy, the R&S®TMU9evo offers a new feature: Rohde&Schwarz efficiency optimization. This intelligent algorithm, deployed either at the press of a button or adaptively, optimizes amplifier parameters while maintaining the required signal quality. Whether changing channels or adjusting the transmitter output power, Rohde&Schwarz efficiency optimization ensures that the system delivers maximum efficiency at all times.

The R&S®TMU9evo also offers improved adaptive precorrection (ADE). This technology has consistently been optimized for Rohde&Schwarz Doherty amplifiers, making it the most effective and fastest precorrection technology on the market. With these advanced R&S®Tx9evo technologies, network operators are optimally prepared for channel changes and output power adjustments.

Adaptive efficiency optimization minimizes energy costs in all operating scenarios



Without efficiency optimization
- ► No adjustment of power amplifier parameters
- ► Low efficiency



With efficiency optimization
- ► Adaptively adjusted power amplifier parameters
- ► High efficiency

OPERATIONAL EFFICIENCY IN EVERY ASPECT

Consistent focus on long-lived transmitter design

Like all other R&S®Tx9 transmitters, the R&S®TMU9evo offers excellent quality. Based on decades of experience in transmitter design and built with high-quality components, it offers unmatched reliability and outstanding signal quality. For example, the R&S®TCE901 exciter uses direct digital RF generation to deliver TV signals.

The R&S®TMU9evo is based on the R&S®TMU9 medium-power transmitter, which has been a market success since 2012. Thousands of R&S®TMx9 transmitters are in operation around the world. This exceptional success is a clear statement of how the R&S®TMx9 transmitter platform meets the needs of network operators, both in terms of minimal operating costs and maximum availability. Transmitter development at Rohde&Schwarz has always been focusing on the challenges faced by network operators.

Key features such as frequency agility across the entire IV and V bands and built-in performance analysis capabilities were targeted for improvement in the R&S®TMU9evo, while all of the field-proven strengths of the R&S®TMx9 platform were maintained, including MultiTX and highly optimized, low-attenuation RF power components.

The broad base of installed R&S®TMx9 systems exhibits extremely low failure rates. Based on this established platform, the R&S®TMU9evo demonstrates the same level of proven reliability, keeping off-the-air time to a minimum.

Continuous control of transmitter key performance indicators

The R&S®TMU9evo is able to track its performance with built-in analysis capabilities such as efficiency measurement and integrated signal analysis. These features provide instant feedback about operational parameters through self-monitoring to ensure a consistently high quality of service combined with lowest operational costs.

The integrated signal analysis function continuously measures and outputs shoulder distance and MER values. Operators benefit from this feature because they have full control of the signal quality without having to invest in additional measuring equipment. Furthermore, the R&S®TMU9evo offers broadcast network operators maximum operational convenience. The straightforward definition of boundaries for operational parameters allows a superior level of automation and a significant reduction in infrastructure complexity. This means a new level of simplicity and a reduction in costs.

Enhanced ATSC translator for easier deployment

When the R&S®TMU9evo is deployed as an ATSC translator, it has enhanced features to make operators' lives easier.

The program and system information protocol (PSIP) editing option lets the R&S®TMU9evo detect and display the original transport stream identifier (TSID) and PSIP information in real time. The translator can modify the contents of the PSIP table, including the short name and the major and minor channel numbers of the input stream. It can also forward all dynamic PSIP electronic program guide information without corrupting any data. This R&S®TMU9evo feature eliminates the need for additional external PSIP editing devices, making deployment easier.

If all inputs (ASI and/or RF tuner input) are lost, a static picture can be displayed instead of a blue screen. The transmitter will continuously loop a standard compliant transport stream. The static picture feature can deliver information to viewers. The feature acts as a fallback, letting the transmitter stay on air if no input signal is present and operators can keep and inform viewers.

When operating as a translator, the R&S®TMU9evo supports the loopthrough of the ASI signal. The transmitter can demodulate the RF input signal and the operator can monitor incoming ASI signals at the baseband level. An ASI test system or ASI transport stream reader can analyze the decoded RF input signal via the ASI output port to help simplify translator station system designs and gain insight into the root cause of any problems.

Innovative redundancy concepts at all levels

The R&S®TMU9evo comes with an optional, integrated exciter backup battery, a feature that is unique in this power class. The battery minimizes the negative effects of mains voltage interruptions. It powers the CPU and the signal processing components during voltage interruptions, preventing a reboot of the transmitter for interruptions of up to 10 seconds. The battery effectively reduces off-the-air time, offering an economic alternative to using an uninterruptible power supply (UPS).

Optional power supply redundancy for the amplifiers also helps increase availability. If one of the power supplies fails, the standby unit delivers the full current. This ensures interruption-free transmission even if a power supply or a phase in the feed network fails. Redundant power supplies are hot-pluggable and can be easily replaced during operation.

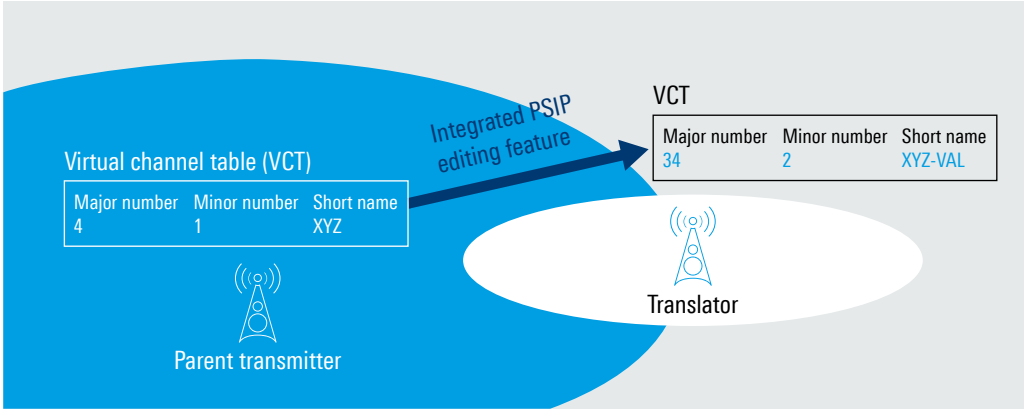
At the transmitter level, the R&S®TMU9evo uses the familiar backup drive redundancy concept deployed by the R&S®TMU9 transmitter family and comprising only two R&S®TCE901 exciters. The passive exciter monitors and controls the active exciter, making a centralized control unit superfluous. The backup drive configuration offers the functionality and convenience of a classic exciter redundancy configuration and increases transmitter availability.

At the system level, the R&S®TMU9evo offers an innovative redundancy configuration: BackupTX.

In a BackupTX system, two R&S®TMU9evo transmitters operate in a fully symmetrical 1+1 configuration. The two transmitters monitor each other, making extra hardware for system monitoring and control unnecessary. Doing away with a separate, governing control unit eliminates the risk of a single point of failure. The BackupTX configuration offers the functionality and convenience of a classic passive standby configuration and also increases the availability of transmitter functionality. BackupTX systems require considerably less space than conventional 1+1 systems.

For example, a 400 W R&S®TMU9evo BackupTX system with integrated DVB-S/S2 receivers requires just seven rack units, saving an enormous amount of space compared to conventional 1+1 backup configurations in this power class. This is a major advantage when space is at a premium.

Adjust PSIP information easily without additional devices



COMPACT DESIGN AND EASY OPERATION

Compact, expandable exciter

The R&S®TMU9evo transmitter family comes with the new R&S®TCE901 exciter, which offers an even higher level of integration than the previous R&S®TCE900 model. It integrates signal processing as well as transmitter and system control functionality. The R&S®TCE901 offers numerous functions and options that eliminate the need for equipment such as an integrated satellite receiver or integrated system components for N+1 configurations. This saves space and increases system availability.

The new R&S®TCE901 exciter supports the latest functionality implemented in the R&S®TMU9evo, such as adaptive efficiency optimization and performance analysis capabilities.

The R&S®TCE901 is multifunctional and extremely versatile. It supports the DVB-T, DVB-T2, ISDB-T/ISDB-T_B and ATSC digital TV standards. Together with the R&S®SDE900 software based encoder, it provides a future-ready solution for ATSC 3.0. Multiple standards can be implemented in a single exciter, allowing switchover between transmission standards (e.g. from DVB-T to DVB-T2) at the push of a button without any hardware modifications. The R&S®TCE901 is also well prepared to handle future transmission standards.

MultiTX configurations

The MultiTX concept makes it possible to install up to six transmitters in a single rack.

Easy and efficient operation

The R&S®TMU9evo graphical user interface (GUI) offers broadcast network operators the convenience they want and need when installing, commissioning and operating transmitters. The transmitter is simple and intuitive to operate. The home screen provides a complete overview of the current operational status of the transmitter and its individual components. The optional R&S®TDU901 transmitter display unit allows fast and convenient operation of the transmitter system via a 7" touchscreen. In addition, a web interface is available that makes it possible to operate the transmitter either locally or remotely, or to integrate it into a network management system via SNMP.

Whether via touchscreen or web interface, the user benefits from the same convenient GUI used throughout the R&S®Tx9 transmitter generation. If multiple, different transmitters from the R&S®Tx9 generation are installed in a broadcast network, the well-designed, uniform GUI significantly reduces training effort for service personnel.

The task-based menu shows the different tasks that can be performed with the transmitter. The tasks and their individual steps are presented in a well-structured layout so that they can be accomplished in a minimum of time. For example, when putting the transmitter into operation, the operator is guided through the configuration of the different devices and given help when entering parameters and changing settings.

The device-based menu provides a graphical view of the transmitter structure. The user simply touches a component to directly access its parameters.

The R&S®TMU9evo comprising the R&S®TCE901 exciter and the R&S®PMU905 amplifier with 400 W output power

FUTURE-READY ATSC 3.0 SUPPORT

R&S®SDE900 server based exciter solution

The ATSC 3.0 broadcast standard was defined to give broadcast network operators a great degree of flexibility in their service offerings. It was designed to evolve together with broadcasters' future requirements. To optimally address network operators' needs for flexibility, Rohde&Schwarz took a revolutionary approach to implement this broadcast standard. The R&S®SDE900 is a purely software based solution – ideal for network operators to make optimal use of ATSC 3.0. Based on a high-performance IT server, it enables network operators to fully leverage the capabilities of the standard and flexibly respond to future signal processing requirements.

The Rohde&Schwarz exciter solution fully supports ATSC 3.0 features such as multiple physical layer pipes (PLP), multiple subframes and SFN capabilities for optimal utilization of valuable spectrum. The R&S®SDE900 also supports ATSC 3.0 layered division multiplexing (LDM), helping network operators maximize coverage in different reception scenarios (e.g. fixed and mobile reception).

By design, the R&S®SDE900 can easily accommodate broadcast standard evolutions. Operators benefit from a secure investment and can optimally exploit their valuable spectrum assets since the Rohde&Schwarz solution allows flexible adaptation to broadcasters' future operational roadmap.

The R&S®SDE900 is designed as a plug-in rackmount module for R&S®Tx9 generation transmitters, allowing a smooth migration to the ATSC 3.0 standard. The R&S®SDE900 software based encoder delivers the I/Q data. The field-proven R&S®TCE901 exciter uses this data to generate the COFDM waveform and applies the most powerful precorrection on the market, delivering the excellent signal quality expected from Rohde&Schwarz.

Server based exciter solution

Real-time ATSC 3.0 software based encoder running on a high-performance server

COFDM waveform generation

ROHDE&SCHWARZ – THE PARTNER YOU CAN COUNT ON

Quality transmitters since 1949

Rohde&Schwarz has developed and produced quality transmitters for 75 years. During this time, the transmitters have been continuously enhanced with new and improved functionality.

The company stands for quality, precision and innovation in all fields of wireless communications. As an independent, family-owned company, Rohde&Schwarz finances its growth from its own funds. The company is not bound by the commitment to achieve short-term, quarterly results. It plans for the long-term, which greatly benefits customers. Purchasing Rohde&Schwarz products is a safe investment.

10-year spare parts availability

Rohde&Schwarz ensures its customers spare parts availability for a period of 10 years after delivery of the product. Broadcast network operators can count on professional, expert support from Rohde&Schwarz during the entire life of their transmitters.

Rohde&Schwarz transmitters offer investment protection unparalleled on the broadcast market.

SPECIFICATIONS

Specifications		
Digital TV		
Standards		DVB-T, DVB-T2, ISDB-T_B, DTMB, ATSC, ATSC 3.0
Channel bandwidth	DVB-T	5 MHz, 6 MHz, 7 MHz, 8 MHz
	DVB-T2	1.7 MHz, 5 MHz, 6 MHz, 7 MHz, 8 MHz
	ISDB-T/ISDB-T_B, DTMB	6 MHz, 8 MHz
	ATSC, ATSC 3.0	6 MHz
Inputs	DVB-T, DVB-T2, DTMB	2 × ASI (BNC, 75 Ω), 2 × TSoIP (Gigabit Ethernet)
	ISDB-T/ISDB-T_B	2 × BTS (BNC, 75 Ω), 2 × TSoIP (Gigabit Ethernet)
	ATSC	2 × SMPTE 310M (BNC, 75 Ω)/2 × ASI (BNC, 75 Ω) 2 × TSoIP (Gigabit Ethernet)
	ATSC 3.0	2 × STL or TSoIP (Gigabit Ethernet)
	DVB-S/S2 signal feed (optional)	2 × F (75 Ω)
General data		
Frequency range	UHF bands IV and V	470 MHz to 790 MHz (790 MHz to 862 MHz on request)
Supply voltage		230 V ± 15 %, 2 wires + PE (L1/N/PE); 400 V/230 V ± 15 %, 4 wires + PE (L1/L2/L3/N/PE); 208 V ± 10 %, 3 wires + PE (L1/L2/L3/PE); 240 V ± 10 %, 2 wires + PE (L1/L2/PE); 50 Hz to 60 Hz ± 5 %
Maximum installation altitude		2000 m above sea level (> 2000 m on request)
Operating temperature range		+1 °C to +45 °C
Relative humidity		max. 95 %, non-condensing
Immunity [1]	to fast transients and bursts in line with IEC 61000-4-4	±2 kV (AC supply), ±1 kV (signal inputs)
	to surges in line with IEC 61000-4-5	symmetrical: ±1 kV (e.g. L-N), asymmetrical: ±2 kV (e.g. L-PE, N-PE)
Synchronization		
Reference frequency		10 MHz, 0.1 V to 5 V (V_{pp}) or TTL (BNC)
Reference pulse		1 Hz, TTL (BNC)
GPS/GLONASS receiver sensitivity	optional	–144 dBm to –5 dBm (SMA)
Integrated OCXO		bridges reference signal interruptions for up to 24 h
Operation		
Status panel with buttons and LEDs		local operation
Transmitter display unit with touchscreen	optional	local display and operation
Ethernet interface, RJ-45		web interface: local, remote; network management interface via SNMP
Parallel remote interface	optional	floating contacts for messages and commands

[1] To satisfy more stringent requirements, appropriate measures must be implemented at the transmitter site.

To comply with the applicable standards and limit values for the suppression of out-of-band emissions and for maintaining the required shoulder distance, the transmitter may only be operated with suitable filters at the RF output.

ORDERING INFORMATION

Your local Rohde&Schwarz expert will help find the best solution for you.
Contact your local Rohde&Schwarz sales office for more information, www.sales.rohde-schwarz.com

Service at Rohde&Schwarz
You're in great hands

- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

Rohde&Schwarz

The Rohde&Schwarz technology group is among the trailblazers when it comes to paving the way for a safer and connected world with its leading solutions in test&measurement, technology systems and networks&cybersecurity. Founded 90 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

Sustainable product design

- Environmental compatibility and eco-footprint
- Energy efficiency and low emissions
- Longevity and optimized total cost of ownership

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

Rohde&Schwarz training
www.training.rohde-schwarz.com

Rohde&Schwarz customer support
www.rohde-schwarz.com/support

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R&S®TMU9evo Air-Cooled UHF Transmitter Family
Data without tolerance limits is not binding | Subject to change

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